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A REVIEW OF AUSTRALIAN SPECIES OF *AUSTROCYLICHNA, NIPPONATYS, CYLICHNATYS* AND *DINIATYS* (MOLLUSCA: GASTROPODA: HAMINOEIDAE)

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SUMMARY

Recent and Tertiary species of *Austrocylichna* Burn, *Nipponatys* Kuroda and Habe, *Cylichnatys* Kuroda and Habe, and *Diniatys* Iredale from Australia are reviewed. Seven species are recognized: *Austrocylichna exigua* (A. Adams), *A. leucampyx* sp. nov., *A. lagena* sp. nov., *Nipponatys tumida* sp. nov., *Cylichnatys campanula* sp. nov., *C. darraghi* sp. nov., and *Diniatys dentifera* (A. Adams). The anatomy of the four genera, particularly the form of the gastral plates, indicates their systematic position in the family Haminoeidae. Also, a hitherto misidentified species from Japan is renamed as *Limulatys habei* sp. nov.

INTRODUCTION

The family Haminoeidae is well represented in temperate and tropical Australia, where many species live from the highest intertidal zone to beyond the edge of the continental shelf. Most species occur in the lower intertidal zone and at moderate depths. A few species have very colourful animals, many have drab or dark animals, and many more have slender cream animals adapted to a fully burrowing life.

The first species of Haminoeidae from Australia was described by Gray in 1825 (*Bulla wallisii*, locality 'New Holland', now *Haminoea wallisii* (Gray)). Additional species were described by Quoy and Gaimard (1833), A. Adams (1850, 1854), Angas (1877), Brazier (1877), Watson (1886), Hedley (1904, 1912), Iredale (1936), and Burn (1966). Further species have been recorded or reported upon in the papers of these and other authors. Not all species were well described and figured, nor are all recognizable at the present time.

In a review of the Japanese species of Haminoeidae, Habe (1952) utilized all previous attempts at subdividing the family, and added a number of new generic and subgeneric groupings, not all of which (especially those relating to *Haminoea* s.l.) have met with general acceptance. In a few instances, the radula and gastral plates were described and figured. Zilch (1959) took a more moderate view of Habe's classification, and reduced most of his genera to subgenera, or to synonymy. More recently, Nordsieck (1972) closely followed Zilch's arrangement of the taxonomy, and added yet another subgenus.

Transference of genera from and to the Haminoeidae has also occured. Bouchet (1975) has shown that *Cylichnium* Dall belongs to the Scaphandridae, where Habe (1955) had already placed it according to shell characters. *Diniatys* Iredale, originally allied to *Atys,* was listed among the Scaphandridae by Schepman (1913) and others, here reverts to the Haminoeidae. *Austrocylichna* Burn, placed in the Scaphandridae, is also relocated in the present family.

Not a great deal is known of the anatomy and biology of the Australian, and world, species of Haminoeidae. In those cases where these aspects are known, it has helped substantiate the existing divisions of the family.

ABBREVIATIONS

A.M. Australian Museum, Sydney
B.M.N.H. British Museum (Natural History), London
coll. collected
Colln Collection
N.M.V. National Museum of Victoria, Melbourne
N.S.W. New South Wales
Qld Queensland
Q.V.M. Queen Victoria Museum, Launceston
S.A. South Australia
S.A.M. South Australian Museum, Adelaide
Tasm. Tasmania
T.M. Tasmanian Museum, Hobart
Vic. Victoria
W.A. Western Australia
W.A.M. Western Australian Museum, Perth

TAXONOMY

Family Haminoeidae Pilsbry, 1895

This family name comes into use in place of the widely accepted Atyidae Thiele (1925) for two reasons.

1. In accord with I.C.Z.N. Article 23(d) (i), Haminoeidae based upon Hamineinae Pilsbry (1895) has priority over Atyidae Thiele (1925), because the former is the oldest valid family-group name.
2. Atyidae Thiele (1925), based upon the taxon *Atys* Montfort (1810), is a junior homonym of Atyidae in Crustacea, based upon the freshwater shrimp taxon *Atya* Leach (1816). To overcome this homonymy, it would be necessary to refer the matter to the I.C.Z.N. (Article 55(a)) for a decision, at the same time drawing attention to the requirements of Article 23(d) (i) and (ii) regarding priority and the upset to general usage.

   In an apparent attempt to circumvent this homonymy, Habe (1961) wrote the family name Atycidae, with Haminoeidae as the alternative. Later (1964), he transposed these names, at the same time reverting to the original spelling Atyidae. Being aware of, but at the time, unable to resolve the problem satisfactorily, the writer (Burn, 1974) wrote the name Atysidae, and provided lists of opisthobranch identifications incorporating this spelling to others for publication (Poore and Rainer, 1974; Coleman, 1976).

Relationships within and without the Haminoeidae have been discussed recently by Rudman (1971, 1972). He placed the family, along with the Smaragdinellidae and Bullactidae, in the superfamily Atyoida. In a later systematic classification, Thompson (1976) equates this superfamily with the suborder Atyacea. Both higher taxa must be altered to accord with the family name, i.e. Haminoeoida and Haminoeacea.

Genera currently assigned to the Haminoeidae are:

Atys Montfort, 1810
Aliculastrum Pilsbry, 1896
Roxaniella Monterosato, 1884
Cylichnatys Kuroda and Habe, 1952

Limulatys Iredale, 1936
(= *Tepidatys* Iredale, 1936)
Weinkauffia A. Adams, 1858
Austrocylichna Burn, 1974
Mimatys Habe, 1952
Micratys Habe, 1952
Sphaeratys Nordsieck, 1972
Nipponatys Kuroda and Habe, 1952
Diniatys Iredale, 1936
(? = *Micraenigma* Berry, 1953)
Liloa Pilsbry, 1921
Haminoea Turton and Kingston, 1830

Doubtful:
Osorattis Iredale, 1929
Spissitydeus Iredale, 1936

As all these genera (except *Nipponatys*, *Cylichnatys* and *Austrocylichna)* were created solely upon shell characteristics, it is difficult to judge how well they will survive future research. Where the anatomy has been studied, it has generally qualified the divisions based upon the shell. By combination of shell and animal features, the four taxa reviewed here must be regarded as distinct genera.

Genus *Austrocylichna* Burn, 1974:44

Type species: (original designation) *Bulla (Atys) exigua* A. Adams, 1850.

DIAGNOSIS: Shell of 1½ whorls, ovate, slender, weakly spirally striated anteriorly and posteriorly, smooth medially; vertex concave, shallow or excavate; columella straight, with wide labrum behind which a deep slender umbilicus; posterior aperture projecting well beyond vertex, inner margin twisted.

Animal with head posteriorly bilobed and ridge-like Hancock's organs; foot short, truncate behind, with small parapodia. Jaw elements large; radula with 4.1.1.1.4 teeth, central broad and without cusps, lateral tooth denticulate, marginal teeth slender and smooth; gastral plates three, with transverse straight spiny ribs. Male copulatory organ with high plicae in atium, and large prostrate gland.

REMARKS: Similarities of the radular teeth to those of the Scaphandridae led to *Austrocylichna* originally being classified in that family. Comparison of its radula, and animal and shell features, with the other genera in this paper induce the writer to transfer *Austrocylichna* to the Haminoeidae. In so doing, special emphasis has been placed upon (1) the twisted inner lip of the posterior aperture, (2) the presence of only 1½ whorls of shell with the inner whorls resorbed or dissolved away, (3) the ridge-like Hancock's organs, (4) the broad base of the central tooth, and (5) the general shape of the chitinous gastral plates and the spiny transverse ribs.

As far as the writer is aware, all species of Scaphandridae retain the innermost whorls and protoconch of their shell at all stages of growth. Lemche (1948) described and figured this part of the shell of many northern Atlantic species, and the writer's experience with Australian scaphandrids confirms Lemche's findings. On the other hand, Marcus (1957, 1958) noted the dissolved or resorbed inner whorls and tightly folded cord of periostracum in *Haminoea elegans* (Gray) from Brazil, and it has since been reported for other species of Haminoeidae (Marcus and Burch, 1965; Burn, 1969; Marcus, 1970, 1972). Resorbtion of the inner shell occurs in *Austrocylichna* and the other genera reviewed in this paper, and would seem, from the available information, to be a good characteristic of the family Haminoeidae.

The Haminoeidae, and the whole Haminoeacea, have three chitinous gastral plates, each curled under anteriorly and with a rounded projection at each end on the outer side. Transverse ribs, straight or meeting at an angle at the median crest, ornament the inner face of the plates in almost every species. The plates in *Austrocylichna* are of this kind. A few species have superficially smooth plates, but even in these incipient ribs can be seen at the curled under anterior end. In the Scaphandridae, there are three or two calcareous gastral plates, the surface of which is smooth.

In shell shape, *Austrocylichna* belongs to the group of *Atys, Aliculastrum, Limulatys* and *Weinkauffia,* all with the posterior aperture projecting beyond the vertex and the inner lip twisted. It has not the inflated shape of the first, is umbilicate and more slender than the second, has not the folded columella of the third, nor the abruptly truncated columella of the last. The radula of the type species, *A. exigua,* has a broad smooth-edged central tooth similar to that in *Nipponatys,* but that genus has a smooth lateral tooth whereas in *A. exigua* it is denticulate.

Three species of *Austrocylichna* are distinguished, *A. exigua* (A. Adams) from shallow waters of southern Australia, *A. leucamnyx* sp. nov. from eastern Australia, and *A. lagena* sp. nov. from the edge of the southern continental shelf.

Austrocylichna exigua (A. Adams)

Figures 1-7

Bulla (Atys) exigua A. Adams, 1850:589, pl. 125, fig. 129; Angas, 1878:869
Atys exigua Sowerby, 1869: pl. 4, fig. 19; Pilsbry, 1893:270, pl. 28, fig. 24.
Roxania exigua Tate & May, 1901:417; Pritchard & Gatliff, 1903:213; May, 1921:103; 1923: pl. 46, fig. 13; Cotton & Godfrey, 1933:82, pl. 1, fig. 11.
Damoniella exigua Cotton & Godfrey, 1938:33; Macpherson & Chapple, 1951:139; May, 1958: pl. 46, fig. 13; Cotton, 1959:406; Macpherson & Gabriel, 1962:246.
Austrocylichna exigua Burn, 1974:46, fig. 1-5; Poore & Rainer, 1974:408.

DIAGNOSIS: Shell of 1½ whorls, small to medium size, thin but solid, elongate ovoid to subcylindrical in shape, rarely angulated at mid-length, slightly narrower posteriorly, diameter less than half length, anteriorly rounded, posteriorly obliquely truncated. Spiral striae strong anteriorly, up to 20 in number, weak posteriorly, up to 8 in number, or obsolete; axial threads not developed. Aperture slender, parallel anteriorly and narrowing to third quarter, posteriorly wider, inner margin twisted and rising sharply from vertex. Columella long, straight or slightly twisted, with wide labrum projecting over slender deep umbilicus. Vertex shallowly concave, sometimes with a crescentic perforation of little depth. Colour of fresh shells translucent with opaque anterior quarter and posterior fifth, of dead shells entirely opaque white; periostracum thin, fragile, yellowish-fawn.

DIMENSIONS:	Length	Diameter	D:L
Holotype (with broken lip)	4.0 mm	2.0 mm	50%
Swan Estuary, W.A.M. (70.2565)	5.7	2.4	42.1
Outer Harbour, S.A.M.	5.56	2.3	41.4
(T.D.1042)	2.74	1.26	45.9
Hardwick Bay, A.M.	5.5	2.42	44.0
(C13302)	1.7	0.8	47.0
Mallacoota, A.M.	4.44	2.2	49.5
(C50562)			
Port Phillip, N.M.V.	4.42	1.75	39.6
(F30108)			
Cape Portland, T.M.	2.42	1.1	45.4
(E7746)	1.5	0.625	41.3

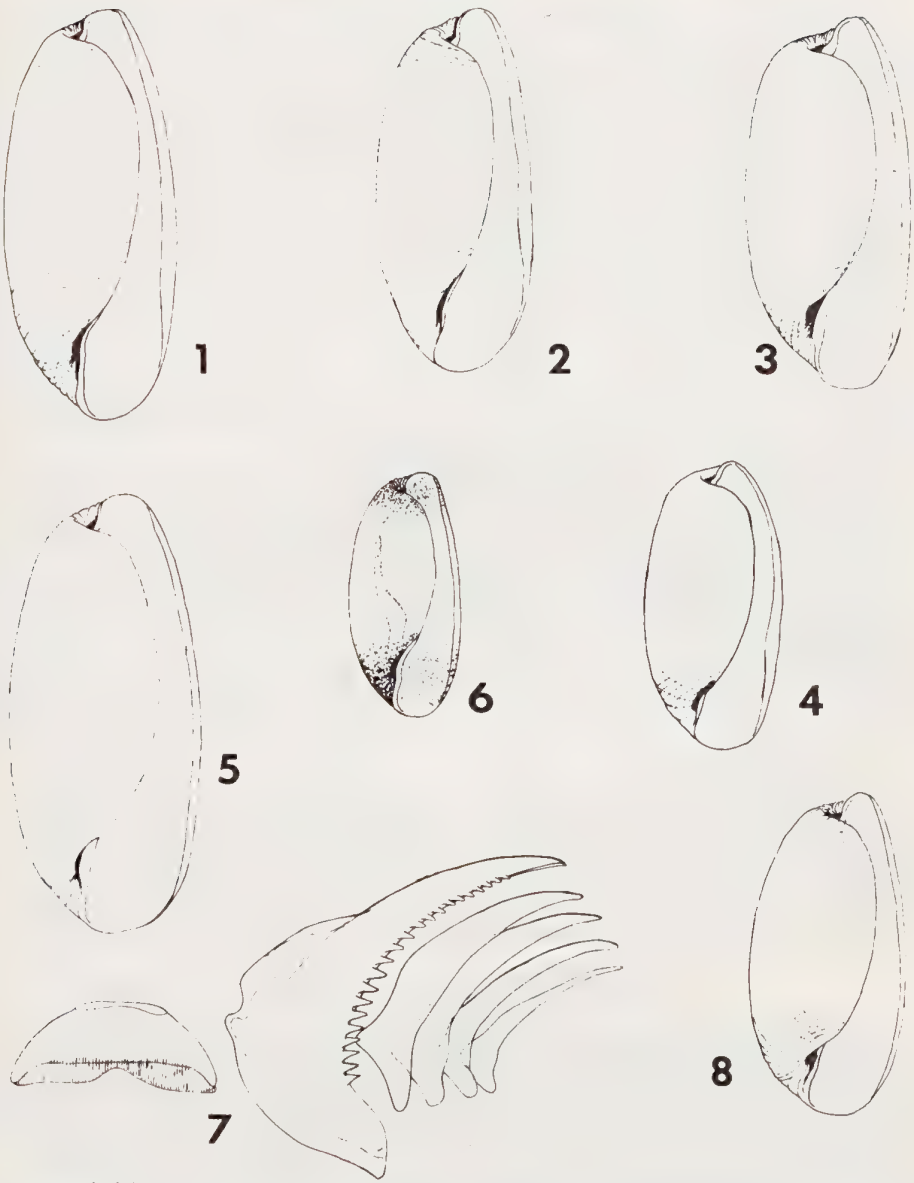
Animal in preservative yellowish-cream with black eyes. Head small, wider than long, with shallow emargination in front edge, bilobed behind, lobes well separated. Hancock's organs a thickened ridge on the body wall below each lobe of head. Seminal furrow with high margins. A broad flat oral lobe each side of mouth, projecting beyond anterior edge of head. Foot short and broad, rounded in front and behind, with small triangular parapodia covering only anterior part of shell; epipodium large, filling posterior aperture. Gill elongate triangular, with 6 transverse bipartite lamellae. Male copulatory organ crosses under oesophagus to left side of head and curls back to median line; atium small and short, with several high plicae distinct from seminal groove which continues through a shorter muscular duct to the soft, bulky prostate gland with wide lumen.

Jaws composed of a pair of areas of few large polygonal elements, similar to that in *Cylichnatys campanula* sp. nov. Radula hyaline, 0.36 mm long, with 23 rows of 4.1.1.4 teeth; central tooth with broad striated base and thickened smooth edge, lateral tooth large, 100 μm long, scaphandroidal in shape with cusp bearing 20-25 large pointed denticles along the edge, marginal teeth slender, curved. Gastral plates 3, haminoeoid in form, each about 0.5 mm long, yellowish, with 10 chevron-like brownish ribs from which pointed elements project. Oesophagus without crop between pharynx and gizzard, nerve ring in front of pharynx.

LOCATION OF TYPE: B.M.N.H. Holotype (19748)

TYPE LOCALITY: Port Lincoln, S.A.

ADDITIONAL MATERIAL EXAMINED: 4 km SSW of Patterson River mouth, Port Phillip, Vic., 8 m in sandy-mud, 1968-1973, coll. Marine Pollution Group, Fisheries & Wildlife Division



FIGURES 1-8.

1-7. *Austrocylichna exigua* (A. Adams). 1, Off Lakes Entrance, Vic., 37 m (N.M.V. F30110). 2, Off Portsea, Port Phillip, Vic. (N.M.V. F30109). 3, Off Point Cook, Port Phillip, Vic., 15 m (N.M.V. F27917). 4, Rocky Bay, Swan Estuary, W.A., 3-7 m (W.A.M. 2.74). 5 & 6, Outer Harbour, St. Vincent Gulf, S.A. (S.A.M. T.D.1042). 7, Radular teeth, 4 km SSW of Patterson River mouth, Port Phillip, Vic., 8 m (N.M.V. F27918).

8. *Austrocylichna leucampyx* sp. nov. Woody Point, Moreton Bay, Qld, holotype (N.M.V. F29802).

ALL FIGURES OF SHELLS ARE x 12, EXCEPT FIGURE 11 WHICH IS x 25.

(N.M.V. F27918, 5 preserved spec.). Off Point Cook, Port Phillip, Vic., 15 m, coll. C.J. Gabriel (N.M.V. F27917, 22 spec.). Port Phillip, Vic., coll. T. Worcester, Gabriel Colln (N.M.V. F30108, 2 spec.). Off Portsea, Port Phillip, Vic., coll. C.J. Gabriel (N.M.V. F30109, 1 spec.). Off Lakes Entrance, Vic., 37 m, coll. W.S. Ayres, Gabriel Colln (N.M.V. F30110, 1 spec.). Mallacoota, Vic., coll. R. Bell (A.M. C50562, 1 spec.). White Beach, Tasman Peninsula, Tasm., October 1967, coll. A. Dartnall (T.M. E10102, 1 spec.). D'Entrecasteaux Channel, Tasm. (T.M. 18378/E2843, 1 spec.). Cape Portland, Tasm., 15 May 1970, coll. G. Davis (T.M. E7746, 7 spec.). Aldinga Bay, St. Vincent Gulf, S.A., coll. R. Tate (A.M. 6710, 9 spec.). Hardwick Bay, Spencer Gulf, S.A., coll. W. Bednall (A.M. C13302, 43 spec.). Outer Harbour, St. Vincent Gulf, S.A. (S.A.M. T.D.1042, 10 spec.). Rocky Bay (stn 4), Swan Estuary, W.A., 16 January 1973, coll. P.N. Chalmers & G.W. Kendrick (W.A.M. 2.74, 1 spec.). Dredge spoil from between old railway and road bridges, Swan Estuary, North Fremantle, February 1964, coll. G.W. Kendrick, (W.A.M. 70.2565, 1 spec.:? Middle Holocene).

DISTRIBUTION AND HABITAT: Eastern Victoria and Tasmania to south Western Australia, ?Middle Holocene to Recent, 8-37 m in fine sandy-mud.

REMARKS: Although considerable variation in shell shape can be seen in the large number of specimens examined, the range of variation is present within single populations and is of no significance. Specimens angulate at mid-length are very uncommon; these are usually large and thickened. Subcylindrical specimens are more common, and could be confused with *Nipponatys tumida* sp. nov. but for the presence of the umbilicus.

A. exigua and *A. leucampyx* sp. nov. are closely allied, but the latter has a shorter columella, wider umbilicus, fewer (10-12) anterior spiral striae, stronger axial sculpture, and lacteous axial bands. The deep-water *A. lagena* sp. nov. is larger and relatively broader, with wide columella and wide umbilicus.

The Holotype, examined in May 1974, is a very dead shell without sculpture, labrum, anterior and outer lips. It compared well with other well worn shells attributed to *A. exigua*, particularly in the shape of the posterior aperture and twisted inner lip, in the long columella, and in the slender deep umbilicus.

In older collections, *A. exigua* has often been confused with *Volvulella rostrata* (A. Adams), hence the literature records cannot be taken as correct. The report by Pritchard and Gatliff (1903: 213) of the species from Westernport is incorrect, their specimens in the N.M.V. from this locality are *Nipponatys tumida* sp. nov.

A single specimen from the top 1 m at the west end of a fresh rock fall at the Pleistocene deposit at Minim Cove, Mossman Park, Perth, W.A. (W.A.M. 77.2222) is very close to small *Nipponatys tumida* sp. nov. in shape and proportions, but differs in the greater infilling of the vertex and the presence of a deep narrow groove behind the short straight columella leading to a slender umbilicus. It differs from *A. exigua* in the broadly ovoid shape and lower posterior lip, yet seems best placed in *Austrocylichna*. More material will be required before any decision can be made regarding the proper placement of this specimen.

Austrocylichna leucampyx sp. nov.

Figure 7

DIAGNOSIS: Shell of 1½ whorls, small to medium size, thin but solid, ovoid to subcylindrical, broadest at anterior third, rarely slightly angular at mid-length, narrowing posteriorly and contracted slightly just below the shoulder, diameter equals half length, anteriorly broadly rounded, posteriorly obliquely truncate. Spiral striae weak, 10-12 shallow striae anteriorly, 2-4 very faint striae posteriorly; axial threads raised, prominent at shoulder and near columella. Aperture slender, anteriorly parallel and narrowing to third-quarter, posteriorly little wider, inner margin slightly twisted and emerging vertically from vertex. Columella short, with shallow truncation at mid-length, with very slender labrum; umbilicus deep and wide. Vertex shallowly concave. Colour translucent white with broad axial milky bands, or entirely dull white.

DIMENSIONS:	Length	Diameter	D/L
Holotype	3.6 mm	1.74 mm	48.3%
Paratypes	3.6	1.82	50.5
	4.6	(broken lip)	— — —
	3.24	1.78	54.8

Animal not known.

LOCATION OF TYPES: N.M.V. Holotype (F29802) and 7 paratypes (F29803).

TYPE LOCALITY: Woody Point, Moreton Bay, Qld., September 1963, coll. J. Kerslake.

DISTRIBUTION: Known only from type locality.

REMARKS: Judged by the number of specimens in the type series, *A. leucampyx* is not uncommon at the type locality, and ought be found living there. The species is very close to *A. exigua*, but differs by being broadest at the anterior third, by having a shorter columella and wider umbilicus, and by having stronger axial threads.

A. leucampyx is perhaps identical with *Ventomnestia colorata* Iredale (1936) from Sydney Harbour, New South Wales, which species is, according to the description and figure, longer (6 mm) and relatively narrower (2.5 mm or 41.7%), cylindrical in shape with irregularly spaced spiral striae over the whole shell, and cream in colour with a broad pale brown band. Apparently *V. colorata* is known only from its original collection. The systematic position of *Ventomnestia* is doubtful; Iredale (1936) call it a 'Cylichnid' (i.e. Scaphandridae), while Habe (1950 et seq.) has consistantly treated it as a genus of the family Retusidae. *A. leucampyx* has only 1½ whorls, therefore is a haminoeid.

The specific taxon, from the Greek leukos – white plus ampyx – headdress, fillet, refers to the axial milky bands of the shell.

Austrocylichna lagena sp. nov.

Figure 9

DIAGNOSIS: Shell with internal whorls, medium to large, fairly solid, subpyriform to subcylindrical, broadest at anterior quarter to third, narrowing posteriorly, diameter more than half length, anteriorly narrowly rounded, posteriorly obliquely truncate. Spiral striae weak, 5-10 shallow striae anteriorly only; axial threads visible but not developed, shell quite smooth. Aperture slender, widest at anterior quarter and narrowing to third quarter, posteriorly very little wider, inner margin slightly twisted and thickened, emerging at a steep angle from the vertex. Columella long, broad with a shallow twist at mid-length, thickened, with very narrow labrum; umbilicus deep and wide. Vertex concave, with or without shallow crescentic perforation. Colour pale fawn or cream.

DIMENSIONS:	Length	Diameter	D/L
Holotype	6.42 mm	3.5 mm	54.5%
Paratype 1	6.875	3.75	54.5
2	5.04	2.83	56.1

Animal not known

LOCATION OF TYPES: S.A.M. Holotype (D16169) and paratype 1 (D16170). N.M.V. Paratype 2 (F30111).

TYPE LOCALITY: Off Cape Jaffa, S.A., 238 m, 1905, coll. J.C. Verco.

DISTRIBUTION: Known only from type locality.

REMARKS: It is extremely doubtful that *A. lagena* is correctly placed in *Austrocylichna*, or even in the Haminoeidae, because of the retention of all the inner whorls. It is probably a species of Scaphandridae, yet does not easily fit into any existing generic group. Nor can its true systematic position be resolved until the animal is known. It approaches closely the shell from 1200 m off the coast of Portugal, identified by Bouchet (1976: 3 58) as *Roxania* (?) *semilaevis* (Seguenza), the animal of which is also unknown.

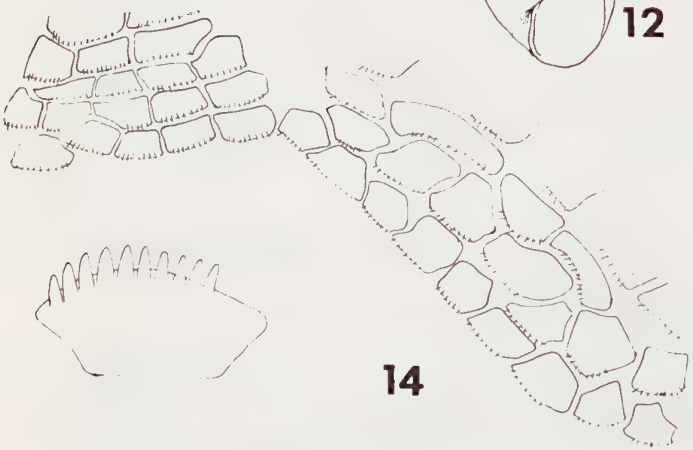
It is of some interest to note that, according to the label with the specimens, Charles Hedley in November 1908 said of this species 'Unknown, on the border between *Atys* and *Cylichna*'.

The specific name, from the Latin lagena – a large jar or bottle with handles and a narrow neck, refers to the general shape of the shell.

Genus *Nipponatys* Kuroda & Habe, 1952: 72

Type species: (original designation) *Atys (Alicula) volvulina* A. Adams, 1862.

DIAGNOSIS: Shell of 1½ whorls, ovoid, broadly fusiform, spirally striated anteriorly and posteriorly; vertex perforated or shallowly concave; columella short, oblique, weakly truncate anteriorly; posterior aperture projecting little beyond vertex, inner margin a little twisted.



FIGURES 9-14.

9. *Austrocylichna lagena* sp. nov. Off Cape Jaffa, S.A., 238 m; holotype (S.A.M. D16169).
10. *Nipponatys tumida* sp. nov. Thompsons Creek at playground, Breamlea, Vic., from spoil excavated from 2 m below water level, holotype (N.M.V. F29798).
11-14. *Cylichnatys campanula* sp. nov. 11, Rottnest Island, W.A., disused quarry in shell bed, SW corner of Lake Baghdad (W.A.M. 77.81, Middle Holocene). 12, N side of Rocky Point reef, E end of Bluff Road, Yanakie, Corner Inlet, Vic., holotype (N.M.V. F30112). 13, Living animal, Foster Beach, Corner Inlet, Vic. (N.M.V. F30114). 14, Jaw and elements, N side of Rocky Point reef, E end of Bluff Road, Yanakie, Corner Inlet, Vic., paratype (N.M.V. F30113).

Animal unknown Radula with 4 1 4 teeth per row; central tooth broad and smooth, lateral teeth all of same slender horn-shape and smooth; gastral plates "*Atys* - type".

REMARKS: The type species, *N. volvulina* (A. Adams), originally collected from 48 m at the island of Tsu-shima in Korea Strait, is recorded from a number of localities on the Sea of Japan coasts of Kyushu and Honshu, Japan (Habe, 1952). The species was described briefly by A. Adams who likened it to a *Volvulella* with a sunken spire. The shell was first figured by Habe (1952), who also provided information of the radula and gastral plates. The genus and species remain little known.

The short oblique columella, weakly truncate anteriorly, and the smooth central and lateral teeth distinguish *Nipponatys* from other haminoeid genera. In *N. tumida* sp. nov., the weakly truncate columella is seen to be quite abruptly truncate when viewed obliquely across the aperture. The columella is not as strongly built nor so prominently truncated as that of *Diniatys*.

In shell shape, *Nipponatys* is grouped with *Roxaniella, Cylichnatys* and *Diniatys*. These genera, and the larger *Liloa*, have a very short, slightly twisted or simply curved inner lip of the posterior aperture, the lip of which projects little beyond the vertex. *Aliculastrum*, to which the type species was originally attributed subgenerically, has a similar oblique columella but is very much larger, the central tooth has a single cusp and incipient lateral cusps, and the lateral tooth is denticulate. The smooth central tooth of *N. volvulina* is like that of *Austrocylichna*, but in that genus the lateral tooth is both differentiated in shape and size, and denticulate, the shell is umbilicate, and the columella straight.

The new species, *N. tumida*, described below, is widely distributed in southern and eastern Australia, apparently still living in the warmer waters of the latter, but extinct in the former area.

Nipponatys tumida sp. nov.

Figure 10

DIAGNOSIS: Shell of variable thickness, broadly ovoid, diameter half length, anteriorly and posteriorly broadly rounded. Spirally striated over whole shell, striations weaker medially, in some specimens striations almost obsolete; axial threads prominent posteriorly at shoulder and anteriorly near columella. Aperture broad anteriorly and narrowing to third-quarter, posteriorly wider, inner margin slightly twisted and rising obliquely from vertex. Columella oblique, straight, weakly and obliquely truncated within aperture, with broad labrum reflected on to body whorl. Vertex shallowly concave. Colour opaque to dull white, periostracum thin, pale brown, darker brown in striations.

DIMENSIONS	Length	Diameter	D:L
Holotype	4.6 mm	2.36 mm	51.3%
Largest paratype	5.04	2.375	47.1
Largest specimen (Barwon Heads)	6.0	2.83	47.3
Smallest specimen (Roches Beach)	1.72	0.92	53.5

Animal not known

LOCATION OF TYPES: N.M.V. Holotype (F29798) and 5 paratypes (F29799). 1 paratype in A.M. (C65697), S.A.M. (D16171), and W.A.M.

TYPE LOCALITY: Thompsons Creek at playground, Breamlea, Victoria, from spoil excavated from 2 m below water level, 1975-1977, coll. R. Burn and K.N. Bell. Middle Holocene.

ADDITIONAL MATERIAL EXAMINED: Woody Point, Moreton Bay, Qld, September 1963, coll. J. Kerslake (N.M.V. F29795, 1 spec.). Barwon Heads, Vic., from gas main excavation on N. side of road 2 km along Geelong road, 1975, coll. R. Burn and K.N. Bell (N.M.V. F29797, 20 spec.), Middle Holocene. Off "The Nits", Phillip Island, Westernport, Vic., 2 m in soft mud and *Zostera*, coll. R. Burn and R. Plant (N.M.V. F29796, 3 spec.). Off Rhyll, Phillip Island, Westernport, Vic., Gabriel Colln (N.M.V. F29801, 2 spec.), Gatliff Colln (N.M.V. F29800, 2 spec.). Great Taylor Bay, South Bruny Island, Tasm., in mud, coll. A. Dartnall (T.M. E5364, 1 spec.). Roches Beach, Frederick Henry Bay, Tasm., 26 February 1964, coll E. Turner (T.M. E3287). Frederick Henry Bay, Tasm., (Q.V.M. 1977/9/1).

DISTRIBUTION AND HABITAT: Southern Queensland to south-eastern Tasmania, Middle Holocene to Recent, shallow water with soft mud bottom.

REMARKS: There is little variation in the shell throughout the range of this species. Some bigger specimens are slightly less ovoid than the Holotype, and smaller specimens are slightly more ovoid. Some specimens have a more pronounced profile of the posterior lip. Rarely, specimens of *Austrocylichna exigua* from South and south Western Australia are as broad as *N. tumida*, but the latter is immediately distinguished by the oblique columella, the wide labrum, and the absence of an umbilicus. The spiral striations vary a great deal in prominence, from almost obsolete in the type series, to about 10 quite strong anterior striae, to both anterior and posterior striae (Woody Point specimen), to wholly striate (Barwon Heads). From the latter locality, one specimen is quite strongly wholly striate, the striae being equally spaced and alternately broad and deep, narrow and shallow.

N. tumida is closely related to the Japonic *N. volvulina* (A. Adams), but differs in being larger and not as broad, with a lower profile of the posterior lip and a shallower vertex. Thesculpture in *N. volulina* is more pronounced in the figure given by Habe (1952).

Until the discovery of the Moreton Bay specimen with intact periostracum, it was presumed that this species was extinct in Australian waters. None of the specimens from marine localities in Victoria and Tasmania have the appearance of coming from present-day living populations. Where details of collection are available, these indicate recovery from deep within mud, some perhaps dredged from submarine Middle Holocene beds. The type locality, and that at Barwon Heads, both rich in opisthobranch species still living along southern Australian shores, are inland from present coastlines, and are thought to be Middle Holocene in age.

Genus *Cylichnatys* Kuroda & Habe, 1952:51

Type species: (original designation) *Bullinella striata* Yamakawa, 1911 (= *Haminea angusta* Gould, 1859).

DIAGNOSIS: Shell of 1½ whorls, cylindrical or ovoid, weakly striated over entire shell; vertex shallowly concave but not perforated; columella short, curved: posterior lip projecting very little beyond vertex, inner lip simply curved.

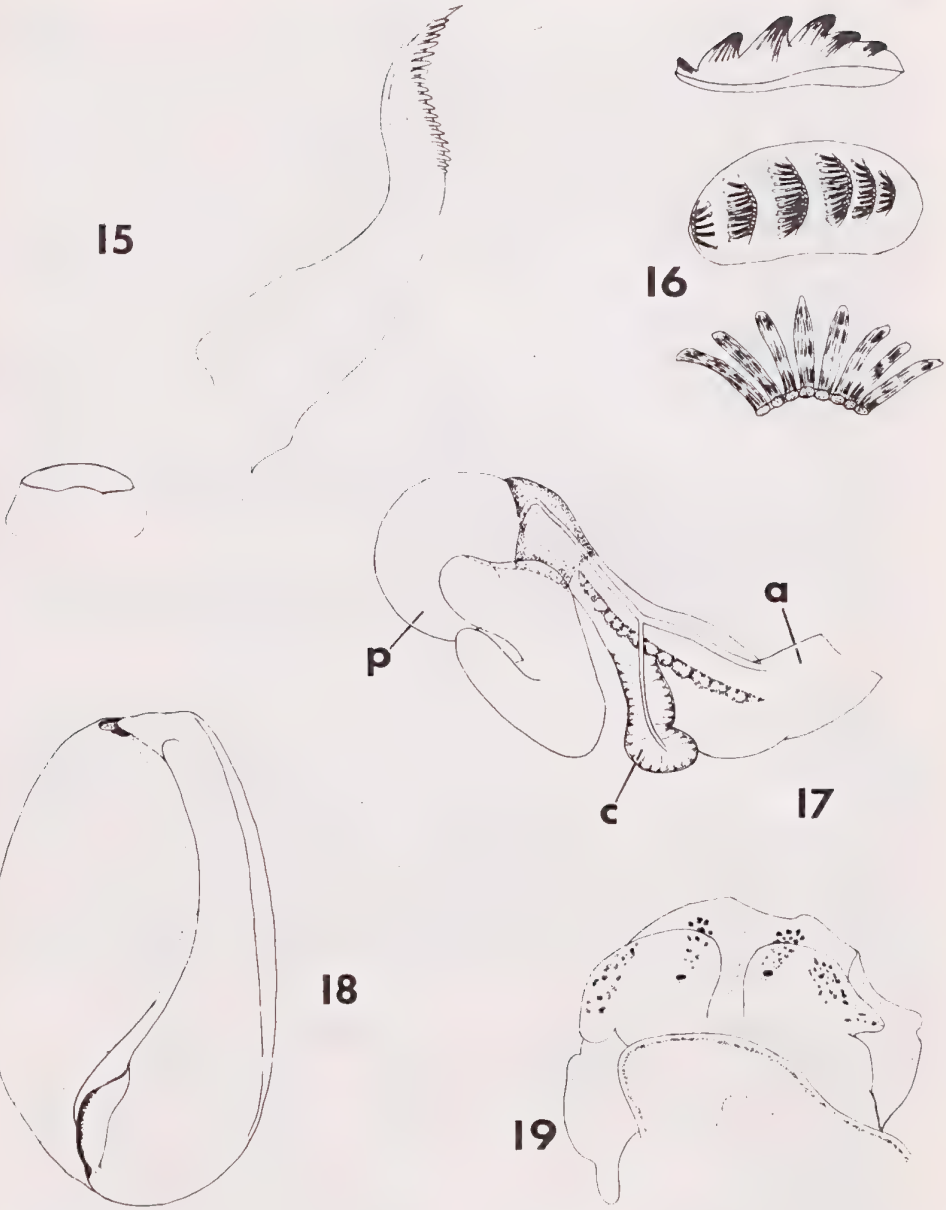
Animal (of *C. campanula* sp. nov.) with subquadrate head, bilobed posteriorly, and with ridge-like Hancock's organs; foot short, truncate behind with small parapodia; epipodium filling posterior aperture, not projecting beyond shell; oral lobes with low sensory papillae. Jaws slender, elements polygonal, denticulate; radula with 1.1.1 teeth, central tooth small, cuspidate or smooth, lateral tooth long, slender, with many fine denticles on inner side and tip; gastral plates three, with chevron-like transverse spiny or knobby ribs. Male copulatory organ comprises long atrium with short caecum at mid-length and long tubular prostate gland.

REMARKS: The narrow radula, slender lateral teeth with comb-like denticles on the inner side, and the entirely striate shell characterize *Cylichnatys*. Some species of *Liloa* have the shell entirely striate, but that genus grows to a much large size, the radula is always broad, and the male copulatory organ is complex with penial papilla, prostate gland and seminal vesicle, and a pair of larger accessory appendages. Sensory papillae on the oral lobes have not been reported elsewhere among the Haminoeidae, but appear to be analogous to the sensory papillae of the Aglajidae.

Cylichnatys is close to, if not identical with *Roxaniella* Monterosato, 1884 from the Mediterranean. Jeffreys' figures (1856: pl. 2, fig. 18-19) of his species, the type of the genus and now called *R. jeffreysi* Weinkauff (1866), are similar to both *C. angusta* and *C. campanula*. The animal of *R. jeffreysi* is not known.

The species described and figured as *R. jeffreysi* by Nordsieck (1972: p. 30, pl. O IV, fig. 24) is slender with an elongate aperture and definite twist of the columella, and quite unlike Jeffreys' figures. Nordsieck's shell is very likely a new species of *Atys*, closely related to *A. macandrewi* E.A. Smith (1872). Specimens in the N.M.V. collection, from Madiera, labelled *Atys jeffreysi* Weinkauff are not that species, but are really *Atys macandrewi* Smith (1872). Marcus (1970) gave some anatomical details for the latter, together with references and distributional data.

Cylichna grimaldii Dautzenberg (1891) from Dakar, Senegal has recently been refered to *Cylichnatys* (Bouchet, 1977:71). Examination of preserved specimens from the same locality, kindly presented by Dr. P. Bouchet, indicates that this species belongs to neither *Cylichna* nor *Cylichnatys*. Its shell is large and entirely striate, the radula is broad, and the male copulatory organ is complex, all features suggesting a close relationship to *Liloa*.



FIGURES 15-19.

15-17. *Cylichnatys campanula* sp. nov., N side of Rocky Point, E end of Bluff Road, Yanakie, Corner Inlet, Vic., paratypes (N.M.V. F30113). 15, Central and lateral radular teeth. 16, Inner face and lateral aspect of gastral plate, and detail of a single rib. 17, Male copulatory organ (a - atrium, c - caecum, p - prostate).

18. *Cylichnatys darraghi* sp. nov., excavation for sewerage tunnel, 12.2 m from surface, below Wright Street, N of Centre Road, Bentleigh, Vic., Black Rock Sands, Cheltenhamian (Upper Miocene/Lower Pliocene), holotype (N.M.V. P48912).

19. *Diniatys dentifera* (A. Adams), head of preserved specimen, Dongara, W.A. (N.M.V. F30118).

Kuroda, Habe & Oyama (1971) give an extensive bibliography and synonymy for *Cylichnatys angusta* (Gould, 1859), which is well-known in Japan from 5-50 m on muddy bottoms in bays, and as a Pleistocene fossil. It is reported as a common species in 10-20 m in the inner bay area of Isukomo Bay, Noto Peninsula, Japan (Habe, 1973). The type specimen of *Haminea angusta* in the United States National Museum (Johnson, 1964) is a badly damaged ovoid shell, barely agreeing with the description by Gould (1859) as "ovate-cylindrical, widened in front, obtusely rounded". Figured specimens, notably those in Habe (1961 and 1964 : pl. 42, fig. 23) and in Kuroda, Habe and Oyama (1971: pl. 115, fig. 1) agree with the original description, whereas another figure (Habe, 1952: pl. 20, fig. 14) shows a decidedly cylindrical shell shape. Specimens in the N.M.V. collection (F29794), from the A. Adams Collection purchased from R.F. Geale in 1870, are from the type locality, Simoda, Japan: Geale labelled them *angustata* from Simonda, following Sowerby (1869) whose errors with this species were carefully corrected by E.A. Smith (1872:348).

As well as pointing out Sowerby's transcription error of writing *angustata* for *angusta*, E.A. Smith (1872:346) described *Atys angustata* from the Gulf of Suez. This has since been regarded as a juvenile of, and relegated to the synonymy of *Aliculastrum cylindricum* (Helbling) (Pilsbry, 1894 : 265). Habe (1952 : 140, pl. 21, fig. 21) and subsequently (1954 : 304, pl. 38, fig. 22; 1955 : 62) included *Limulatys angustata* (Gould, 1859) in his lists of Japanese species. Because this specific name is an incorrect subsequent spelling by Sowerby of the taxon *angusta* (Gould, 1859), it has no status in nomenclature (I.C.Z.N., Article 33(b)). As *Limulatys 'angustata'* (Gould, 1859)' is obviously distinct from *Cylichnatys angusta* (Gould, 1859), it is here named *Limulatys habei* sp. nov. The specimen figured from Söyö-maru Station 4, off Katsuura, Bōsō Peninsula, Japan, 287 m, 16 June 1926, is designated as the holotype.

Two Australian species are described, *C. campanula* sp. nov. from living populations along the southern Australian coastline and from Pleistocene and Middle Holocene deposits, and *C. darraghi* sp. nov. from strata of the Miocene-Pliocene boundary in the Tertiary of Victoria.

Cylichnatys campanula sp. nov.

Figures 11-17

DIAGNOSIS: Shell of 1½ whorls, thin to fairly solid, cylindrical to broadly ovoid, broadest at mid-length, diameter generally half, but varying from one-third to two thirds of length, broadly rounded at both ends, sometimes more or less truncate posteriorly. Spiral striae strong to weak, generally narrow, wavy and shallow, occasionally broad, straight and rather deep, with or without raised axial threads crossing the striae, which if present create a secondary reticulation, striae about 40 in number, stronger anteriorly, posteriorly obsolete in some specimens; axial threads sometimes prominent anteriorly and at vertex. Aperture broad anteriorly, narrower and parallel posteriorly, inner margin simply curved, rising very obliquely from vertex. Columella short, curved, very little thickened, labrum small, at junction of columella and body whorl. Vertex very shallowly concave. Colour transparent with opaque anterior and posterior ends in living and fresh shells, opaque white in dead shells; periostracum very thin, yellowish.

DIMENSIONS:	Length	Diameter	D/L
Holotype	2.9 mm	1.57 mm	54.1%
Paratypes	3.14	1.62	51.5
	2.96	1.42	47.3
Cape Portland, Tasm.	3.76	1.36	36.2
(T.M. E7747)	1.04	0.6	57.7
Hardwick Bay, S.A.			
(A.M. C13311)	2.6	1.28	49.2
Cockburn Sound, W.A.			
(W.A.M. 597.77)	2.24	1.14	50.9
Rocky Bay, W.A.			
(W.A.M. 241.73)	3.32	1.52	45.8
Rottnest Island, W.A.			
(W.A.M. 77.208)	2.58	1.46	56.6

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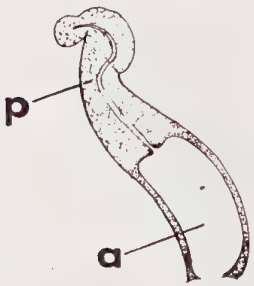

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FIGURES 20-25

20-25. *Diniatys dentifera* (A. Adams), Dongara, W.A. 20, Hancock's organ from left side of head (N.M.V. F30118), 21, Jaw elements and single element (N.M.V. F30118). 22, Aspects of gastral plates and detail of a single rib (N.M.V. F30118). 23, Central and lateral radular teeth (N.M.V. F30118). 24, Male copulatory organ (a - atrium, p - prostate) (N.M.V. F30118). 25, Shell (W.A.M. 1879-69).

Animal translucent greyish with opaque pigment cells, prominent black eyes, brownish-red speckling on Hancock's organs, and reddish gut in mid-line of head; spots and patches, sometimes large areas, of black pigment on inner surface of dorsal wall of pallial cavity, visible dorsally through shell. Head subquadrate, with sinuate anterior edge and paired posterior lobes, Hancock's organs ridge-like, low. Each side of mouth a rounded oral lobe, bearing an elongate triangular area of crimson-coloured scattered low papillae, probably sensory in use. Foot short and broad, truncate in front and behind, with small parapodia touching only anterior part of shell; epipodium filling posterior aperture and not extending beyond shell, used in crawling. Pallial cavity apparently devoid of branchia. Male copulatory organ crosses under pharynx to left side, with prostate gland filling most of space between pharynx and gizzard, a little more than 1 mm straightened out; atrium slender, thin, with long muscular thickenings; short, bent caecum with deeply folded epithelium branches off at mid-length of atrium; lumen of atrium continues through soft fleshy section at fundus to folded tubular white prostate gland.

Jaws formed of two narrow strips, each 180 μm long and 40 μm wide or about 12 elements long by 3-4 rows of elements deep; elements large, polygonal, with up to 12 denticles along longest margin. Radula with 16-17 rows of 1.1.1 teeth, central tooth narrow with smooth edge 20 μm wide, lateral tooth 100 μm long, slender and somewhat twisted with 18-20 comb-like denticles along edge to cusp. Gastral plates three, haminoeid in shape but rather flattened on the outer face, about 340 μm long, with 5-7 high chevron-like transverse knobby ribs, each built up by 3-12 curved rods visible within each plate, in colour dark brown or pale with dark ribs.

LOCATION OF TYPES: N.M.V. Holotype (F30112, preserved spec.) and 4 paratypes (F30113, 3 preserved spec. and 1 shell). One paratype (Shell) in W.A.M., S.A.M., and A.M. (C65698).

TYPE LOCALITY: *Zostera* and mud flats, N side of Rocky Point reef, E end of Bluff Road, Yanakie, Corner Inlet, Vic., 11 April 1971 and 1 April 1972, coll. K.N. Bell.

ADDITIONAL MATERIAL EXAMINED: Foster Beach, Corner Inlet, Vic., *Zostera* and mud flats, 22 March 1974, coll. R. Burn (N.M.V. F30114, 1 preserved specimen). Port Albert, Corner Inlet, Vic., *Zostera* and mud flats at swimming area, 15 April 1978, coll. R. Burn & K.N. Bell (N.M.V. F29804, 3 preserved specimens and 1 shell). Wallagaraugh River, at bridge on Fairhaven Road, near Mallacoota, Vic., 20 February 1973, coll. B.J. Smith and R. Plant (N.M.V. F30115, 8 preserved specimens). Pambula, N.S.W., coll Mrs. Forde (A.M. C11775, 1 juvenile spec.). Tasmania, 1886, coll. C.E. Beddome, Helms Colln (A.M. C87690, 1 spec.). Cape Portland, Tasm., 15 May 1970, coll. G. Davis (T.M. E7747, 25 spec.). Spring Beach, near Orford, Tasm., 2 February 1970, coll E. Turner (T.M. E7568, 1 spec.). N of Mt. Younghusband, St. Peters Island, Nuyts Archipelago, S.A., *Zostera* and mud at low tide, January 1978, coll. D. Howlett (N.M.V. F30116, 1 spec.). Hardwick Bay, Spencer Gulf, S.A., coll. H.L. Kesteven (A.M. C13311, 15 spec.). Rocky Bay (stn 3), Swan Estuary, W.A., 7-9 m in western channel, 16 January 1973, coll. P.N. Chalmers & G.W. Kendrick (W.A.M. 3.74, 6 spec.). Rocky Bay (stn 4), Swan Estuary, W.A., 3-7 m on slope at W end of sand bank, 16 January 1973, coll. P.N. Chalmers & G.W. Kendrick (W.A.M. 241.73, 25 spec.). Approx 3 km N of Rockingham, Cockburn Sound, W.A., 18 m mud bottom, 16 January 1965, coll. R. Slack-Smith & G.W. Kendrick (W.A.M. 597.77, 74 spec.). FOSSIL RECORDS: MIDDLE HOLOCENE: Rottnest Island, W.A.; disused quarry in shell bed, SW corner of Lake Baghdad, 6 January 1977, coll. G.W. Kendrick (W.A.M. 77.81, 81 spec.); quarry at E end of Lake Baghdad, site 2, 5 January 1977, coll. G.W. Kendrick (W.A.M. 77 387, 51 spec.); quarry at E side of Government House Lake, 6 January 1977, coll. G.W. Kendrick (W.A.M. 77.428, 9 spec.); spit at junction between Serpentine and Government House Lakes, 10 January 1977, coll. P.E. Playford (W.A.M. 77.493, 34 spec.); island at E end of Herschel Lake, 6 January 1977, coll. G.W. Kendrick (W.A.M. 77.208, 69 spec.); quarry at E end of Lake Baghdad, 5 January 1977, coll. G.W. Kendrick (W.A.M. 77.299, 39 spec.). Point Waylen, Attadale, W.A.; excavation depth 80-100 cm, 2 March 1971, coll. G.W. Kendrick (W.A.M. 76.2450, 3 spec.); excavation depth 100-120 cm, 2 March 1971, coll. G.W. Kendrick (W.A.M. 76.2316, 7 spec.). Swan Estuary, opposite Roberts Road, Attadale, W.A., dredge spoil, 31 March 1966, coll. G.W. Kendrick (W.A.M. 70.2342, 1 spec.). Swan Estuary, Como, W.A., dredge spoil from between Preston and Thelma Streets, 2-3 March 1972, coll. G.W. Kendrick (W.A.M. 72.166, 1 spec.). Beckenham, W.A., 3 Wimbldon Street, excavation between house and Canning River, 1.5-3 m deep, 1966, coll. J. Horwood (W.A.M. 70.2384, 1 spec.). East Rockingham, W.A., well on E side of Mandurah Road, 28 July 1959, coll. G.W. Kendrick (W.A.M. 76.557, 7 spec.). Barragup Bridge, E of Mandurah on road to Pinjarra, W.A., Main Roads

Department bore stn 776.60, depth 3.75-4 m, 3 March 1976, coll. M. Willey & M. Limb (W.A.M. 76-2698, 21 spec.). Lake Clifton, W.A.; lake bed on E side adjacent to old cement factory site, one spade depth, 14 January 1962, coll. E.P. Hodgkin & G.W. Kendrick (W.A.M. 75-254, 44 spec.); *Agonis* thicket on E side, near old cement factory, from an excavation in apparently undisturbed ground, about 0.5 m below surface, 14 January 1962, coll. E.P. Hodgkin & G.W. Kendrick (W.A.M. 76.606, 12 spec.). Australind, near Collie River bridge on Bunbury Road, W.A., dredge spoil from channel deepening deposited along bank, 30 March 1969, coll. H. Merrifield (W.A.M. 75.342, 1 spec.) Leschenault Inlet, W.A., west side, from inlet borehole no. 3 at 10.0 - 11.5 m below present sea level, 1974, coll. R. Barnes (W.A.M. 74.217, 4 spec.). PLEISTOCENE: Minum Cove, Mosman Park, W.A.; W end at fresh rock fall, top 1 m, 27 February 1966, coll. G.W. Kendrick (W.A.M. 77.1344, 18 spec.); lower sample, October 1955, coll. G.W. Kendrick (W.A.M. 69.1507, 5 spec.). Peppermint Grove, W.A., near Scotch College boatshed, 1965, coll. G. Byrne (W.A.M. 68.878, 8 spec.); 12 April 1968, coll. G.W. Kendrick (W.A.M. 68.950, 1 spec.); 14 June 1972, coll. G.W. Kendrick (W.A.M. 77.2518, 2 spec.; N.M.V. P48911, 10 spec.).

DISTRIBUTION AND HABITAT: Southern N.S.W. Victoria E of Wilsons Promontory and eastern Tasmania, and St. Vincent Gulf, South Australia to the Swan Estuary, south Western Australia, Pleistocene to Recent, intertidal *Zostera* and mud flats to 18 m on mud.

REMARKS: *C. campanula* is very close to the small specimens of *C. angusta* (Gould) from Simoda, Japan, in the collection of the National Museum of Victoria (N.M.V. F29794), from which the shell is distinquished only by the courser sculpture and the presence of the small labrum. *C. angusta* grows much larger, a specimen from Obama Bay, Honshu figured by Habe (1952: pl. 20, fig. 14) measured 7.3 x 3.7 mm, another from Sagami Bay figured by Kuroda, Habe and Oyama (1971: pl. 115, fig. 1) measured 8.3 x 4.4 mm. *C. campanula* further differs from *C. angusta* in the absence of a cusp on the central radular tooth, the larger base of the lateral tooth, and the oval shape of the gastral plates. *C. angusta*, like *C. campanula*, has only 1½ whorls of shell.

There is a consistent degree of variation in the shell of *C. campanula* over its distribution along the southern coast of Australia and in its fossil record. Shell shape varies from cylindrical to ovoid and sculpture from weak to strong. Though specimens from eastern Victoria and Tasmania tend to be more cylindrical and less strongly sculptured, similar shells occur within populations from South and Western Australia, and therefore cannot be distinguished. The animal, known only from eastern Victoria and western South Australia, shows no differences.

In some older collections from Tasmania and South Australia, *C. campanula* was found confused with juvenile specimens of *Retusa* spp., but is separated by the open shape of the posterior aperture, the shallow vertex, and the presence of 1½ shell whorls.

Prior to the discovery of *C. campanula* alive in 1971, the species was not known from Victoria, nor is it present in the Gatliff, Gabriel or general collections in the National Museum of Victoria. At the present time, the species apparently does not occur along the Victorian coastline W of Wilsons Promontory, for despite much assiduous collecting in Westernport and Port Phillip, no specimens have been found, either dead or alive. Nor has the species been found during extensive studies of Middle Holocene beds in central and western Victorian coastal areas. It is therefore possible, though unlikely, that *C. campanula* is a species that has only very recently colonized the eastern Victorian coastline. Against this, however, must be judged the earliest collecting record of the species, that by C.E. Beddome from Tasmania in or prior to 1886, indicating that it has been in south-eastern Australia for a relatively short time at least.

C. campanula has a fairly long record from Pleistocene to Recent in Western Australia, although as yet no living specimens have been reported, nor has it been found along the southern coast E of Cape Leeuwin. In South Australia, the species has been found alive at St. Peters Island in the west, and dead in both Spencer and St. Vincents Gulfs, but appears to be absent from the SE of the State. In all probability, *C. campanula* is a species which in the Pleistocene or earlier was distributed along the whole southern coastline, but which, due to changes in coastline and temperature, now persists in an eastern and a western population, separated by a gap of 1000 km of relatively colder water.

The occurrence of *C. campanula* in the Wallagaraugh River, at the bridge on the Fairhaven Road, near Mallacoota, suggests that the species can tolerate a large range of salinities. The Wallagaraugh River at this point is 18 km from the sea, and within sight of the rock sill that marks the termination of estuarine conditions in the river. At the time of collection, the height of a

dry Australian summer, the estuary system of which this river is part had a salinity almost equal to that of the open sea, and a number of marine molluscs were able to rapidly populate the whole of the estuary, apparently to its uppermost reaches.

Salinity tolerance and the ability to rapidly populate help explain the present Middle Holocene and Pleistocene occurrences of the species in the Perth area of Western Australia.

The species is named for Mr K.N. Bell of Stony Creek, Victoria, who first discovered it alive (Latin campanula - a little bell).

Cylichnatys darraghi sp. nov.

Figure 18

DIAGNOSIS: Shell with internal whorls, medium to large, solid, ovoid, broadest at mid-length, slightly narrower posteriorly, diameter more than half length, anteriorly broadly rounded, posteriorly narrowly truncate. Spiral striae weak, up to 30 striae anteriorly, closer and deeper near columella, and up to 8 striae posteriorly; axial threads not developed, shell smooth. Aperture broad anteriorly, narrowing posteriorly then parallel; inner margin of posterior aperture thickened, simply curved, rising laterally from vertex. Columella short, curved, thickened; labrum large, very strong and thickened, in many larger specimens projecting ventrally from columella as a sharply raised ridge. Vertex completely filled in and level with body whorl, in some large specimens an eroded curved furrow is present dorsally around the edge of the vertex. Colour, that of the matrix, light orange brown.

DIMENSIONS:	Length	Diameter	D/L
Holotype	5.42 mm	3.17 mm	58.4%
Paratypes	6.41	3.5	54.6
	5.5	3.0	54.5
	3.21	1.875	58.4
	3.175	1.83	57.6

DIMENSIONS: N.M.V. Holotype (P48912) and 118 paratypes (P48913)

TYPE LOCALITY: Excavation for sewerage tunnel, 12.2 m from surface, below Wright Street, N of Centre Road, Bentleigh, Vic., coll. T.A. Darragh and H.E. Wilkinson; Black Rock Sands, Cheltenhamian, Upper Miocene/Lower Pliocene.

DISTRIBUTION: Known only from type locality.

REMARKS: As with the systematic position of *Austrocylichna lagena* sp. nov., the presence of complete internal whorling mitigates against the placement of *C. darraghi* sp. nov. in *Cylichnatys*, which genus it otherwise closely resembles. Comparison with all Tertiary and Recent Australian cephalaspidean opisthobranchs reveals no close relationships, nor is it close to any of the world's species in the available literature. It is most probably a species of Scaphandridae, possibly of the group of genera that includes *Cylichnella, Cylichnium* and *Taita.*

The species is named for Mr T.A. Darragh, Acting Director, National Museum of Victoria, and President of the Malacological Society of Australia, who collected the only known series of specimens.

Genus *Diniatys* Iredale 1936:329

Dinia H. & A. Adams, September 1854:21 (non Walker, May 1854).

Type species: (original designation) *Bulla (Atys) dentifera* A. Adams, 1850.

DIAGNOSIS: Shell of 1½ whorls, ovoid, broad; finely spirally striate, vertex shallow, not perforate; columella abruptly truncate, ending with a tooth-like projection, umbilicus not present; posterior aperture projecting little beyond vertex, inner lip simply curved.

Animal with subquadrate head bilobed posteriorly with lobes folded forward on to head, and with vertically plicate, large triangular Hancock's organs; foot short, truncate behind, with small parapodia; epipodium filling posterior aperture but not projecting as tail. Jaw elements oblong, with rounded denticulate edge; radula with 5.1.5 teeth, central tooth broad with three cusps and striated base, lateral teeth all of same slender hammer-shape and smooth; gastral plates three, with slightly arched transverse spiny ribs. Male copulatory organ with tubular atrium and tubular prostate gland.

REMARKS: *Diniatys* has two features which immediately confirm its place in the Haminoeidae: the presence of 1½ whorls only of shell matter, and the three transversely spiny-ribbed gastral plates. It is like *Nipponatys* and *Cylichnatys* in the low profile of the posterior aperture, but is easily distinguished by the presence of the abruptly truncated columella with its tooth-like flange. The number, shape and non-denticulate nature of the lateral teeth recall those of *Nipponatys*, but in that genus the central tooth is smooth. The overall shape of the radular row is close to that in some species of *Haminoea*, but the number of lateral teeth is less than reported in any species. The vertically plicate Hancock's organs also serve to separate *Diniatys* from the genera of this review.

Schepman (1913) placed *Diniatys* (as *Dinia*) in the Scaphandridae as a valid genus, and since then it has been regarded as a subgenus of *Cylichna* in this family by Thiele (1931), Wenz (1959), Maes (1967) and Cernohorsky (1972). It was used as a genus by Pilsbry (1921), Iredale (1929, 1936), Allan (1940) and Habe (1952, 1955, 1961, 1964), whereas Pruvot-Fol (1954) maintained it as a subgenus of *Atys* exactly as propounded by Pilsbry in 1894. A probable synonym of *Diniatys* is the small *Micraenigma* Berry, 1953, whose type species *M. oxystoma* Berry, 1953, from Cedros Island, Baja California is exceedingly like *D. dentifera*.

Two well-known species, *D. dentifera* (A. Adams) and *D. monodonta* (A. Adams) belong to the genus, the former with a wide Indo-Pacific distribution, the latter confined to the western Pacific. A deep-water species, *D. truncatula* (Schepman) is known from 522 m in the Sulu Sea between Borneo and the Philippines. From the Gulf of Suez, *Atys miranda* E.A. Smith was described, and remains unfigured to this day; it was transfered to *Diniatys* by Pilsbry (1894).

Diniatys dentifera (A. Adams, 1850)

Figures 19-25

Bulla (Atys) dentifera A. Adams, 1850 : 588, pl. 125, fig. 124
Atys dentifera Sowerby, 1868 : fig. 13; Cooke, 1886 : 132; Hedley, 1910:370.
Atys (Dinia) dentifera H. & A. Adams, 1854:21; Pilsbry, 1894:276, pl. 27, fig. 81; Kobelt, 1896: 27, pl. 8, fig. 15.
Dinia dentifera Schepman, 1913:471.
Diniatys dentifera Allan, 1940:177, fig.; Habe, 1952:141, pl. 20, fig. 12; Habe, 1955:62; Habe, 1961:89, pl. 42, fig. 24; Habe, 1964:136, pl. 42, fig. 24.
Cylichna (Diniatys) dentifera Wenz, 1959:26, fig. 78; Cernohorsky, 1972:209, pl. 59, fig. 7.
Dinia compitorum Pilsbry, 1921:364, fig. 3.
Cylichna (Diniatys) sp. Maes, 1967:151.

DIAGNOSIS: Shell of 1½ whorls, small to medium size, fairly solid, broadly ovoid to broadly subcylindrical, broadest at mid-length, diameter almost two-thirds length, broadly rounded anteriorly, subtruncate posteriorly. Spiral striae weak to obsolete, strongest anteriorly; axial threads not developed; shell sometimes quite smooth. Aperture broad anteriorly, narrowing posteriorly; inner margin of posterior aperture simply curved, rising obliquely from vertex. Columella short, curved, thickened, labrum not developed; on the inner side a broad thick descending lamina or keel, anteriorly abruptly truncated as a tooth-like projection. Vertex very shallowly concave. Colour transparent with opaque anterior and posterior ends in preserved and fresh shells, opaque white in dead shells.

DIMENSIONS:	Length	Diameter	D/L
Mauritius	4.58 mm	2.875 mm	62.7%
(N.M.V. F30117)			
Dongara	3.125	1.96	61.3
(W.A.M. 1879.69)	3.0	1.96	65.3
	2.58	1.58	61.3
	2.21	1.42	64.2
Minum Cove	5.75	3.46	60.1
(W.A.M. 78.1651)	3.33	2.17	65.0
	2.67	1.67	62.5

Animal in preservative translucent cream with brown pigment cells scattered in narrow bands in posterior lobes of head and in front of eyes, viscera pinkish-orange. Head broadly subquadrate with sinuate anterior margin and paired posterior lobes folded forward covering eyes. Hancock's

organs large, raised, triangular, with up to 6 irregular, sometimes broken, vertical plicae. Each side of mouth a rounded oral lobe. Foot short and broad, truncate in front and behind, with small parapodia covering anterior part of shell; epipodium filling posterior aperture, not extending beyond shell. Male copulatory organ probably not mature, in lower right wall of head cavity, very small, 420 μm long by 80 μm diameter, with smooth-walled atrium, and prostate gland of granular cells and slender lumen. Nerve ring large, with big cerebral, pleural and pedal ganglia clustered round posterior end of pharynx.

Pharynx large, almost 1 mm long, filling most of head cavity; salivary glands small, clavate, filled with granular cells; oesophagus short and broad, without diverticula. Jaws resembling those of *Weinkauffia*, large, shield-shaped, composed of many rows of oblong brownish elements, 20 μm long, from one narrow edge of which project 9-10 points. Radula with 22 rows of 5.1.5 teeth, central tooth 70 μm wide with three cusps and striated base, lateral teeth smooth, initially hamate becoming awl-shaped and smaller marginally, laterals 2, 4 and 5 have cusp lengths of 65, 45 and 33 μm respectively. Gastral plates 3, haminoeoid in shape, about 400 μm long, strongly curved with up to 20 slightly arcuate transverse ribs, each with a row of points; yellowish-brown in colour with darker brown ribs.

LOCATION OF TYPE: B.M.N.H. Holotype. (Not examined).

TYPE LOCALITY: Lord Hood's Island, now Marutea Atoll, Gambier Islands, French Oceania.

ADDITIONAL MATERIAL EXAMINED: Mauritius, R.F. Geale Colln (N.M.V. F30117, 1 spec.). Dongara, W.A., from gut of *Philinopsis cyanea* (Martens), 24 August 1958, coll. B.R. Wilson (W.A.M. 1879.69, 7 preserved spec.; N.M.V. F30118, 3 preserved and 4 dissected spec.). FOSSIL RECORD: PLEISTOCENE: Minum Cove, Mosman Park, W.A., from top 1 m at W end of fresh rock-fall, 27 February 1966, coll. G.W. Kendrick (W.A.M. 78.1651, 10 spec.).

DISTRIBUTION: Indo-West Pacific: Gulf of Suez, Mauritius, Cocos-Keeling Island, Hawaii, Fiji, Cook Islands, southern islands of Japan, Indonesia, Queensland, Western Australia; Pleistocene to Recent, intertidal to 45 m.

REMARKS: *D. dentifera* is easily separated from *D. monodonta* (A. Adams) and *D. truncatula* (Schepman) by its ovoid shape where the diameter equals about two-thirds the length. The original figure by Adams (? of the Holotype) is of a shell 5.5 mm long by 3.6 mm diameter, with D/L of 66%. There appears to be some variation in shell shape in the figures in the literature, with the posterior lip rising somewhat higher than in the present material. The same and greater variation occurs in the Dongara material which is smaller in size than reported from elsewhere. The specimens are both ovoid and broadly subcylindrical, some have the posterior lip almost level with the body whorl, others have it rising very obliquely or a little higher. In four animals examined from shells of various shapes, no anatomical differences were noted.

The Dongara specimens, 14 in all, were found in the gut of a large specimen of the aglajid *Philinopsis cyanea*, together with specimens of *Haminoea* and *Tornatina*. This predator is well-known for its liking of small bubble-shells.

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